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Replacing JB 8891-1999

Limit Values and Measurement Methods for Small and Medium Non-Road Diesel Engine Emissions (Version Submitted for Approval)

Promulgated on 20××－××－××　　Enforced on 20××－××－××

Promulgated by **Standardization Administration of the People's Republic of China**

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The clauses of this Standard are recommended except for Chapter 5 which is mandatory.

This Standard is a revision of JB 8891-1999 “Limit Values for Small and Medium Diesel Engine Gaseous Exhaust Emissions.”

The main differences between this Standard and JB 8891-1999 are:

— It is clearly specified that this Standard is only applicable to non-road diesel engines;

— The emission values are the same as those stated in the United States’ Non-Road Diesel Engine Emission Standards - Tier 1. The exhaust emission is temporarily examined according to GB 9486-20×× Diesel Engine — Exhaust emissions Measurement Method under Steady State conditions;

— The measurement methods are consistent with international standards, adopting GB/T 8190.4-1999 “Reciprocating Internal Combustion Engines — Exhaust Emission Measurement — Part 4: Test Cycles for Different Engine Applications” (idt ISO 8178-4: 1996);

— It controls the emission level of engines according to the requirements of type certification tests and production conformity inspections.

With effect from the enforcement date, this Standard replaces and removes JB 8891-1999.

This Standard is proposed by China Machinery Industry Federation.

This Standard is managed by the China National Technical Standardization Committee for Automobiles.

The main drafting unit of the Standard is Shanghai Internal Combustion Engine Research Unit.

This standard was drafted by (individuals) Zhai Zhunming, Xie Yaping, Song Guochan and Chen Linshan.

Limit Values and Measurement Methods for Small and Medium Non-Road Diesel Engine Emissions

1 Scope

This Standard specifies the limit values and measurement methods for small and medium non-road diesel engine emissions.

This Standard is applicable to non-road motor vehicles, engineering machines, tractors, farming and forestry machines, marine vessels, diesel engines for power generating and fixed applications.

2 Normative References

The clauses contained in the following documents, which are being cited in this Standard, shall become the clauses of this Standard. For all dated references, all their subsequent amendments (exclusive of corrected contents) or revised versions shall be not applicable to the Standard. However, any parties that come to an agreement in accordance with this Standard shall be encouraged to make a study of the possibility of adopting the latest version of the following normative references. Where the references are not dated, their latest versions are applicable to this Standard.

GB/T 6072.1-2000 Reciprocating Internal Combustion Engines — Performance — Part 1: Standard Reference Conditions, Declarations and Test Methods of Power, Fuel and Lubricating Oil (idt ISO 3046-1: 1995)

GB/T 6072.3-2003 Reciprocating Internal Combustion Engines — Performance — Part 3: Test Measurements (idt ISO 3046-3: 1989)

GB/T 8190.1-1999 Reciprocating Internal Combustion Engines — Exhaust Emission Measurement — Part 1: Test-Bed Measurement of Gaseous and Particulate Exhaust Emissions (idt ISO 8178-1: 1996)

GB/T 8190.4-1999 Reciprocating Internal Combustion Engines — Exhaust Emission Measurement — Part 4: Test Cycles for Different Engine Applications (idt ISO 8178-4: 1996)

GB/T 8190.5-20×× Reciprocating Internal Combustion Engines — Exhaust Emission Measurement — Part 5: Test Fuels (idt ISO 8178-5: 1997)

GB 9486-20×× Diesel Engine — Exhaust emission Measurement Method under Steady State conditions

GB/T 10327-1989 Reference Light Diesel Fuel Specification for Engine Performance Test

ISO 8178-6: 2000 Reciprocating Internal Combustion Engines — Exhaust Emission Measurement — Part 6: Report of Measuring Results and Tests

3 Test Conditions

3.1 Testing situation of engine

Measure the intake absolute temperature (T_a) and dry-air pressure (P_s) at the 0.15m from the upper position of the air filter inlet on the engine, or 0.15m from the upper position of intake pipe inlet if an air filter is not installed. Try to make the engine test environment as close to the following standard reference:

Atmospheric temperature (T_a) : 283K ≤ T_a ≤ 313 K

Dry-air pressure (P_s) : 80 kPa ≤ P_s ≤ 110 kPa

3.2 Effectiveness of test

Atmospheric coefficient f_a refers to the effects of environmental situations (pressure, temperature and humidity) on the air absorption of the engine.

For non-charged and mechanical charged engines:

$$f_a = \left(\frac{99}{P_s}\right) \times \left(\frac{T_a}{298}\right)^{0.7} \quad \text{(1)}$$

For turbocharged engines with or without intercooler:

$$f_a = \left(\frac{99}{P_s}\right)^{0.7} \times \left(\frac{T_a}{298}\right)^{1.5} \quad \text{(2)}$$

When the atmospheric coefficient f_a satisfies the following conditions, the test is considered effective:

$$0.98 \leq f_a \leq 1.02$$

3.3 Power

The emission measurement takes the effective power of unrevised adaptation of a new engine as the standard.

The effective power of the engine should be measured according to the methods specified in Appendix B of GB/T 8190.1-1999.

In the type certification test of the engine, the difference between the power tested at the specified rotational speed and the power specified by the engine manufacturer should not be greater than ± 4%.

The difference between the power of engine tested in the production conformity inspection and the power specified by the engine manufacturer in the type certification test should not be greater than ± 5%.

3.4 Intake system

Test the intake system installed in the engine. For engines using air-cleaning filters and operating under running mode according to the maximum air flow situation of the related application, its intake resistance should be within ± 10% of the upper limit specified by manufacturer.

3.5 Air exhaust system

Test the air exhaust system installed in the engine. When the engine is operating in running mode according to the maximum specified power of the related application, its exhaust gas back pressure should be within ± 10% of the upper limit specified by the manufacturer.

3.6 Cooling system

The cooling system applied by the engine should possess sufficient cooling ability, and can keep the working temperature of the engine within the range of normal operating temperature specified by manufacturer.

3.7 Lubricating oil

Record the specifications of the lubricating oil for the test, and write down the test results in the report.

3.8 Test fuel

The fuel specified in GB/T 8190.5-20××, or the light diesel fuel of Chinese origin specified in GB/T 10327-1989 should be used for the test.

The temperature of the fuel should be according to the recommendations of the manufacturer. The temperature of the fuel should be measured at the inlet of injection pump or in the location specified by the manufacturer. The measurement position should be recorded.

3.9 Measurement instruments

The measurement of gaseous and particulate exhaust emissions of engines should be carried out according to the sampling and analytic systems specified in Chapter 15 and Chapter 16 of GB/T 8190.1-1999. Other sampling and analytic systems, if proven to be equally effective, can also be adopted.

The accuracy of all the measurement instruments should meet the requirements of Subsection 7.3 of GB/T 8190.1-1999.

4 Test methods

The procedures of the emission test should be measured and evaluated according to the applications of the engine. Suitable test cycles should be chosen from Table 1.

Table 1 Test Cycles and Weighted Coefficients for Small and Medium Non-Road Diesel Engine Emissions [a]

Running Mode No. (Cycle B)	1	2	3	4	5	6	7	8	9	10	11
Running Mode No. (Cycle C1 [b])	1	2	3		4	5	6	7			8
Rotational Speed [f g]	Rated Rotational Speed					Middle Rotational Speed					Idle Speed
Torque [f g], %	100	75	50		10	100	75	50			0
Weighted Coefficient	0.15	0.15	0.15		0.01	0.1	0.1	0.1			0.15
Running Mode No. (Cycle C2 [c])	1	2	3	4	5						
Rotational Speed [f g]	Rated Rotational Speed					Middle Rotational Speed					Idle Speed
Torsion [f g], %	100	75	50	25	10						
Weighted Coefficient	0.05	0.25	0.3	0.3	0.1						
Running Mode No. (Cycle E3 [d])	1					2	3	4			
Rotational Speed [f g]	100					91	80	63			
Power [f g], %	100					75	50	25			
Weighted Coefficient	0.2					0.5	0.15	0.15			
Running Mode No. (Cycle G2 [e])	1	2	3	4	5						6
Rotational Speed [f g]	Rated Rotational Speed					Middle Rotational Speed					Idle Speed
Torque [f g], %	100	75	50	25	10						0
Weighted Coefficient	0.09	0.2	0.29	0.3	0.07						0.05

a Please refer to detailed requirements in GB/T 8190.4-1999.

b C1 is a test cycle for non-road vehicles and industrial devices.

c D2 is a stable-speed test cycle for intermittent generators, compressor and so on.

d E3 is a test cycle for marine vessels.

e G2 is a test cycle for speed-change engines below 19kW.

f Please refer to Subsection 11.5 of GB/T 8190.1-1999 as well as Chapter 5 and Chapter 6 of GB/T 8190.4-1999.

g In each running mode of test cycle, the torque, rotational speed and the temperature and pressure of all the fluids should be kept unchanged. Their permissible error should meet the requirements specified in Table of GB/T 6072-3.

5 Limit values of emissions

Table 2 Limit Values of Small and Medium Non-Road Diesel Engine Emissions

Stage I (Date of Enforcement: Jan. 2006)						
Power (kW)	NO_x (g/kW-h)	HC (g/kW-h)	NMHC+NO_x (g/kW-h)	CO (g/kW-h)	PM (g/kW-h)	Emission
kW < 8	-	-	10.5	8.0	1.0	According to the requirements of GB9486 - 20××
8 ≤ kW < 19	-	-	9.5	6.6	0.80	
19 ≤ kW < 37	-	-	9.5	5.5	0.80	
37 ≤ kW < 75	9.2	-	-	-	-	
75 ≤ kW < 130	9.2	-	-	-	-	
130 ≤ kW < 225	9.2	1.3	-	11.4	0.54	
225 ≤ kW < 450	9.2	1.3	-	11.4	0.54	
450 ≤ kW < 560	9.2	1.3	-	11.4	0.54	
kW ≥ 560	9.2	1.3	-	11.4	0.54	
Stage II (Date of Enforcement: Jan. 2008)						
Power (kW)	NO_x (g/kW-h)	HC (g/kW-h)	NMHC+NO_x (g/kW-h)	CO (g/kW-h)	PM (g/kW-h)	Emission
kW < 8	-	-	7.5	8.0	0.80	To be specified
8 ≤ kW < 19	-	-	7.5	6.6	0.80	
19 ≤ kW < 37	-	-	7.5	5.5	0.60	
37 ≤ kW < 75	-	-	7.5	5.0	0.40	
75 ≤ kW < 130	-	-	6.6	5.0	0.30	
130 ≤ kW < 225	-	-	6.6	3.5	0.20	
225 ≤ kW < 450	-	-	6.4	3.5	0.20	
450 ≤ kW < 560	-	-	6.4	3.5	0.20	
kW ≥ 560	-	-	6.4	3.5	0.20	
Remarks: The data shown in this table refers to the limit values of engine emissions without treatment of gaseous exhaust emissions.						

5.1 Type certification test

The emission mass of nitrogen oxide (NO_x), hydrocarbon, non-methane hydrocarbon (NMHC), carbon oxide (CO) and particulate material (PM) tested from

engines should not exceed the limit values specified in Table 2.

5.2 Production conformity inspection

5.2.1 Take one adapted engine from a batch of products as the sample. The emission mass of nitrogen oxide (NO_x), hydrocarbon, non-methane hydrocarbon (NMHC), carbon oxide (CO) and particulate material (PM) tested from the engine should not exceed 1.1 times of the values specified in Table 2.

5.2.2 If the adapted engine sampled from a batch of products cannot meet the above requirements, the manufacturer can request that several engines are taken from a batch of products for testing. The manufacturer should confirm the number *n* of the sampled engines for inspection (including the original sampled engine). Apart from the original engine sampled for inspection, all other engines should be tested according to the requirements specified in Chapter 15 and Chapter 16 of GB/T 8190.1-1999. After that, according to the specific emission of each pollutant tested from the *n* samples of engines, the arithmetic mean (X) can be acquired. If the following conditions can be satisfied, the production conformity of this batch of products is considered as passed; otherwise it is deemed to have failed.

$$\bar{X} + k \cdot S \le L_i$$

$$S2 = \sum_{i=1}^{n} \frac{(X_i - \bar{X})^2}{n - 1}$$

In this equation:

L_i — limit value of each pollutant specified in Table 2;

k — statistical factors confirmed according to n, and its numerical value is listed in Table 3;

X_i — test result acquired independently from each of the *n* engines.

Table 3 Statistical Factors

n	2	3	4	5	6	7	8	9	10
k	0.973	0.613	0.489	0.421	0.376	0.342	0.317	0.296	0.279
n	11	12	13	14	15	16	17	18	19
k	0.265	0.253	0.242	0.233	0.224	0.216	0.210	0.203	0.198

If $n \ge 20$, then $k = \frac{0.860}{\sqrt{n}}$

5.2.3 The production conformity inspection frequency is generally once every year. If the sampled engine does not meet the requirements of Subsection 5.2.2, the

supervisory administration should take all necessary measures to re-confirm the production conformity.

6 Test report

The emission test report should be written according to the requirements of ISO 8178-6: 2000. Concrete requirements can be formulated by various parties according to the purposes of tests.